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ABSTRACT

Researchers have attempted to develop paper and pencil Piagetian tests that yield results equivalent to manipulative Piagetian tasks and that can be administered in significantly less time. This study is an attempt to partially replicate and extend the findings of research by Paul Ankeny and Lyle Joyce who found significant positive correlations between a paper and pencil Piagetian test and manipulation Piagetian tasks. It was hypothesized that the scores obtained by 50 fourth-grade students on Ankeny and Joyce's Piagetian Reasoning Test would be positively correlated with the number of manipulative tasks mastered by the students. The Reasoning Test is group administered; it consists of 30 objective questions and assesses operations such as: conservation (of weight, length, area and volume), one-to-one correspondence, class inclusion, transitivity, Euclidean space, spatiality, and velocity. Students were given the Reasoning Test (and classified as concrete operational if they demonstrated mastery on eight or more operations) and were interviewed using Piagetian tasks which paralleled the 10 operations on the Reasoning Test. Results show that a significantly larger portion of students demonstrated concrete operational thought process on task interviews as compared to printed (and oral) questions reflecting the same operations. Implications for decisions concerning the selection of instructional materials and methods are also addressed. (JN)

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Running head: **Reasoning Test**

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A number of researchers (Allison, 1983; Kaufman, 1972; Lawson, 1974; Renner, 1978) have suggested that Piagetian test results can assist educators in the selection of appropriate curricula, materials, and selecting environments for learning. Typically, researchers have sought to validate the preceding contentions by comparing the results obtained from commonly employed tests of I.Q. and achievement to results derived from Piagetian based assessment (DeVries, 1973; Dudek, et.al. 1969; Hathaway 1972; Kuhn, 1976; Wolcott; 1978). Generally, investigators have found significant positive correlations between Piagetian measures and I.Q. or achievement measures. However, educators have been reluctant to routinely employ Piagetian task measures in the evaluation process because Piagetian testing required a significantly greater amount of time to conduct than more traditional testing. Therefore, several researchers (Ankeny and Joyce, 1975; Burney, 1974; Lawson, 1978), have attempted to develop a paper and pencil Piagetian test that yields results equivalent to manipulative Piagetian tasks and that could be administered in significantly less time. In one the few studies examining the concurrent validity of such paper and pencil tests and manipulative Piagetian tasks Ankeny and Joyce (1975) reported significant positive correlations between the two measures.

The purpose of the present study was to attempt to partially replicate and extend Ankeny and Joyce's (1975) findings. Specifically, it was hypothesized that the scores obtained by fourth grade students on the Piagetian Reasoning Test (Ankeny & Joyce, 1975) would be significantly positively correlated with the number of manipulative Piagetian tasks mastered by the students.

Subjects

Subjects in the study were 50 fourth grade students, (I.Q.=110.9, SD=11.6) 27 females and 23 males, randomly selected from a population of 150 students from a middle class agricultural community in Northeast Nebraska.

Instruments and Task Interviews

The Reasoning Test, developed and validated by Ankeny and Joyce (1975) was employed as the paper and pencil Piagetian test. The Reasoning Test is group administered and assesses reasoning at the Piagetian preoperational, transitional, and concrete operational levels. In establishing the Reasoning test's concurrent validity with scores in five individually administered Piagetian Task Interviews, a Pearson correlation coefficient of .63 was reported. A .83 reliability coefficient was obtained using the Kuder-Richardson formula. (Ankeny, 1975).

The Reasoning Test assesses ten operations: (a) conservation of weight, (b) conservation of length, (c) conservation of area, (d) conservation of volume, (e) one-to-one correspondence, (f) class inclusion, (g) transitivity, (h) Euclidean space, (i) spatiality, and (j) velocity. The raw scores on the test range from one to thirty, with three questions relating to each operation. If the student is successful in two or three of the questions on a specific operation mastery is assumed. Students are classified as concrete operational if they demonstrate mastery on eight or more of the ten operations assessed.

The researchers selected representive Piagetian task interviews which parallel the ten operations selected for the reasoning test. Subjects were interviewed according to the descriptions provided by Piaget. The interviewer was trained to criteria during the summer of 1982 while attending graduate school at the University of Northern Iowa. The tasks selected were:

(a) conversation of weight

The Child and Reality

(b) conservation of length

The Child's Conception of Geometry

(c) conservation of area

The Child's Conception of Geometry

(d) conservation of volume

The Child's Conception of Number

(e) one-to-one correspondence

The Child's Conception of Number

(f) class inclusion

Genetic Epistemology

(g) transitivity

Genetic Epistemology

(h) Euclidean space

The Child's Conception of Space

(i) spatiality

The Child's Conception of Geometry

(j) velocity

The Child's Conception of Movement and Speed

Procedures

The Reasoning Test was administered by a graduate assistant in two one-hour sessions on consecutive days. In order to more accurately assess the operational level of students who had reading difficulty, the questions were read orally in addition to providing each student with a printed copy of the instrument.

The ten-task interviews were individually administered to

each subject by the same graduate assistant. Interview sessions normally lasted from 12-15 minutes for the ten tasks.

Results and Discussion

The scores for each student indicating the number of mastered operations in each form of assessment are indicated on Table 1.

Insert Table 1 about here

Statistical analysis of the relationship between each task interview and the corresponding questions on the reasoning test are presented in Table 2. The Correlations ranged from .062 to .386. Only two significant correlations were noted.

Insert Table 2 about here

The data were organized using a forced dichotomy as suggested by Ankeny and Joyce (1975). Students successful in 8 or more operations were catorgorized as concrete operational and those successful on less than eight operations were categorized as preoperational. Statistical analysis of the relationships between preoperational and concrete operational performance on the two

Table I

A Comparison of Successful Operations on the Reasoning Test and Task Interviews

		Reasoning Test								
		2	3	4	5	6	7	8	9	
Task Interviews	4	0	1	0	0	0	0	0	0	1
	5	0	1	0	1	0	0	0	0	2
	6	1	0	0	0	1	0	1	0	3
	7	0	2	3	5	1	1	0	0	12
	8	2	1	1	3	1	3	2	0	13
	9	0	1	0	5	4	4	0	0	14
	10	0	0	0	0	0	3	1	1	5
		3	6	4	14	7	11	4	1	50

Table 2

Relationship Between Task Interview Scores and

Ankeny - Joyce Scores

TEST	ø	Z	P
1) Conservation of weight	.217	1.53	NS
2) Conservation of Length	.254	1.80	P < .05
3) Conservation of Area	.202	1.43	NS
4) Conservation of Volume	.140	.99	NS
5) One-to-One	.149	1.05	NS
6) Class Inclusion	.102	.72	NS
7) Transitivity	.199	1.41	NS
8) Euclidean Space	.062	.44	NS
9) Spatiality	.160	1.13	NS
10) Velocity	.386	2.78	P < .01

forms of testing revealed a weak positive correlation.

Insert Table 3 about here

Five students (10%) were classified as concrete operational using the Reasoning Test, while 32 students (64%) met the necessary qualifications using the task interviews.

The results of this study indicated a larger portion of students reflected performance at the concrete operational level on task interviews as compared to printed and oral questions reflecting the same operations. For research which intends to classify subjects to an exact stage of logical reasoning, the group test is not sufficiently accurate. Furthermore, the Reasoning Test tends to estimate reasoning levels somewhat lower than those obtained on individual task interviews.

Implications For Teaching Science

A variety of Piagetian tests have been developed to ascertain the cognitive level of individuals. A number of professional educators suggest the application of data from Piagetian based testing to make curriculum decisions, and/or select materials for instruction. The rationale is centered on an effort to

Table 3

Cross-tabulation of Pre-operational (0-7) Versus Concrete Operational (8-10) Performance on Ten Piagetian Task Interviews and the Reasoning Test:

A Comparison of Pre-Operational and Concrete Operational Categorization in the Reasoning Test and Task Interviews.

	Reasoning Test		
	Low Score (0 - 7)	High Score (8 - 10)	
Task Interviews: Low Score (0-7)	17	1	18
Task Interviews: High Score (8-10)	28	4	32
	45	5	50

r = .11

improve cognitive matching of instruction, instructional materials, and student groups. This should subsequently result in improved instruction through assigning students learning tasks congruent with their cognitive abilities.

Although this study directed itself to the concurrent validity of two instruments when employed with a population of fourth grade students, the authors believe that the results may have implications for decisions concerning the selection of instructional materials and methods. The ability to equilibrate at a certain cognitive level appears to be affected by the medium as well as the content. Children may be able to actively process concepts and ideas when presented with concrete manipulative materials but unable to grasp the same concepts when they are presented verbally or through pictures. Perhaps the printed materials being used in classrooms insure the frustration of large numbers of students because they cannot engage in active cognitive processing at the level assumed by the authors. The same may be true in lecture-recitation sessions. Hence, students responses to concrete, semi-concrete, and abstract presentations of materials need to be analyzed and reviewed in teaching-learning situations to better insure that instruction is appropriate for the learner.

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